IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

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Corres. to PCT/EP2003/006576

For: HEAT TRANSMITTER ARRANGEMENT

TRANSLATOR'S DECLARATION

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Sir:

I, the below-named translator, certify that I am familiar with both the German and the English language, that I have prepared the attached English translation of International Application No. PCT/EP2003/006576, and that the English translation is a true, faithful and exact translation of the corresponding German language paper.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of legal decisions of any nature based on them.

November 25, 2004

Date

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Heat exchanger arrangement

The invention relates to a heat exchanger arrangement as claimed in the preamble of claim 1.

Turbochargers are used to compress the air in order to increase the performance of engines. In the process, however, the air, which is referred to in the following text as the boost air, is heated, as a result of the compression in the turbocharger, to temperatures of more than 150°C. In order to reduce such air heating, air coolers are used, which are arranged at the front in the cooling module and are used to cool the boost air. The boost air in this case flows through a heat exchanger, through which environmental air flows, and is thus cooled. This allows the boost air to be cooled down to a temperature which is about 40 - 80 K above the temperature of the environmental air.

It is also known for the boost air to be cooled via a coolant circuit. This circuit is referred to in the following text as a low-temperature circuit. In this case, the boost air flows close to the engine through an air cooler to which coolant is applied and which is part of the low-temperature circuit in which the heat is transferred to the coolant. The coolant is pumped through an air/coolant cooler, which is arranged in the front cooling module of the vehicle where the heat is emitted to the environmental air, so that the coolant-cooled boost air cooling is more efficient than air-cooled boost air cooling.

A corresponding heat exchanger arrangement with a boost air cooler is known from DE 197 22 097 A1. In this case, a first heat exchanger in the form of a water/air cooler, a second heat exchanger in the form of a boost air cooler, and a third heat exchanger in the form of a capacitor are arranged in parallel with one another

transversely with respect to the vehicle longitudinal direction in an engine compartment of a motor vehicle, so that they are arranged one behind the other in the direction in which the wind of motion flows through when the motor vehicle is traveling in the normal direction.

However, a heat exchanger arrangement such as this is less than ideal.

The object of the invention is to improve a heat exchanger arrangement of the type mentioned initially.

This object is achieved by a heat exchanger arrangement having the features of claim 1. Advantageous refinements are the subject matter of the dependent claims.

According to the invention, a heat exchanger arrangement having at least three heat exchangers is provided, which are arranged essentially parallel to one another and are firmly connected to one another, with two of the heat exchangers being arranged at the same height as one another when seen in the air flow direction. In this case, the respective inlet and outlet temperatures of the individual heat exchangers should be in similar temperature bands.

The integral configuration saves components since only one part must be installed and mounted in the engine compartment of a motor vehicle. Installation is made easier. Furthermore, considerably reduced physical space depths can be achieved by an appropriate design.

The first of the two heat exchangers which are located at the same height when seen in the air flow direction is preferably arranged above the second heat exchanger. In this case, the first heat exchanger is preferably an

engine coolant cooler, the second heat exchanger is a boost air/coolant cooler, and the third heat exchanger is a condenser.

Two of the heat exchangers, in particular the engine coolant cooler and the boost air/coolant cooler, preferably have a common coolant circuit, although a separate configuration is also possible. If a common coolant circuit is used, the entire coolant flow flows through the engine coolant cooler, in particular, and part of the flow then also flows through the boost air/coolant cooler. The distribution of the coolant flow can be influenced by the configuration of the tubes.

A diversion to a lower level is preferably provided in at least one of the heat exchangers, in particular in the boost air/coolant cooler.

The two heat exchangers which are located at the same level are preferably located behind the third heat exchanger when seen in the air flow direction.

The invention will be explained in detail in the following text using three exemplary embodiments with one variant, and with reference to the drawing, in which:

Figure 1 shows a perspective view of a part of a heat exchanger arrangement according to the first exemplary embodiment;

Figure 2 shows a side view of the heat exchanger arrangement shown in Figure 1;

Figure 3 shows a circuit for boost air cooling according to the first exemplary embodiment;

Figure 4 shows a schematic view of a heat exchanger arrangement according to the second exemplary embodiment;

Figure 5 shows a section through the heat exchanger arrangement shown in Figure 4;

Figure 6 shows an illustration of the coolant circuits according to the second exemplary embodiment; and

Figure 7 shows an illustration of the flow profile according to a variant.

Figures 1 and 2 show a heat exchanger arrangement 1 which has a first heat exchanger in the form of an engine coolant cooler 2, a second heat exchanger in the form of a boost air/coolant cooler 3, and a third heat exchanger in the form of a condenser 4, which are arranged essentially parallel to one another transversely with respect to the vehicle longitudinal direction in an engine compartment in a motor vehicle, so that they are arranged one behind the other or alongside one another in the direction in which the wind of motion flows when the motor vehicle is traveling in the normal direction.

A coolant which cools the engine M is cooled in the engine coolant cooler 2, with the corresponding coolant circuit being referred to in the following text as the engine coolant circuit A.

A coolant which cools the boost air (indirect boost air cooling) is cooled in the boost air/coolant cooler 3, with the corresponding coolant circuit being referred to as the boost air coolant circuit B.

According to the first exemplary embodiment, the boost

air/coolant cooler 3 is arranged underneath the water/air cooler 2. The condenser 4 is arranged both in front of the water/air cooler 2 and in front of the boost air/coolant cooler 3, when seen in the air flow direction. According to the present exemplary embodiment, the two coolant circuits A and B are connected to one another in such a way that, as is illustrated in Figure 3, the coolant passes to the engine coolant cooler 2 via a common inlet 5, a part of the coolant is supplied from this engine coolant cooler 2 (outlet 6) from the engine M and cools this, and the rest of the coolant is passed from the engine coolant cooler 2 to the boost air/coolant cooler 3 (outlet 7), where it is cooled down further and is then supplied to the boost air cooler L, and cools the boost air. The two flow elements of the coolant are combined again, and are once again passed to the engine coolant cooler 2.

The second exemplary embodiment will be described in the following text with reference to Figures 4 and 5, with identical elements or elements having the same effect being provided with reference symbols increased by 100.

Figure 4 shows a schematic illustration of a heat exchanger arrangement 101, with the engine coolant cooler 102 and the condenser 104 not being illustrated, for clarity reasons. A separating wall 110 in order to divert the coolant flowing through the boost air, coolant cooler 103 to a lower level, that is to say forwards when seen in the air flow direction, is provided in the interior of the boost air/coolant cooler 103. In this case, widened ends of bead tubes 111 can be seen. Furthermore, a separating wall 112 is also provided for the engine coolant cooler 102.

According to the second exemplary embodiment, the two

coolant circuits A and B are formed separately, as is illustrated in Figure 6.

Figure 7 shows a variant, on the basis of which, as in the first exemplary embodiment, a common coolant circuit is provided and, as in the second exemplary embodiment, diversion to a lower level is provided in the boost air/coolant cooler in the lower area of the heat exchanger arrangement. The flow profile is indicated by arrows, although the lengths of the arrows should not be understood as indicating the corresponding flow speeds.

List of reference symbols

1, 101, 201, 301	Heat exchanger arrangement
2, 102	Engine coolant cooler
3, 103	Boost air/coolant cooler
4, 104	Condenser
5	Inlet
6	Outlet
7	Outlet
110	Separating wall
111	Bead tube
112	Separating wall
A	Engine coolant circuit
B	Boost air coolant circuit
L	Boost air coolant
M	Engine